

"Express Mail" mailing label number:

EV 335894948 US

## **SYSTEM AND METHOD FOR ACCESSING DIGITAL SUBSCRIBER LINE DATA**

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### **Field of the Disclosure**

[0001] The present application relates to a system and method of accessing digital subscriber line (DSL) data.

### **Background**

[0002] Historically, telephone facilities and the services provided over the telephone facilities had little in common. Today, asynchronous digital subscriber line (ADSL) is a service of an internet service provider (ISP) delivered over specialized ADSL network equipment that is in part owned by two other entities: the data service provider and the incumbent local exchange carrier (LEC). When the ADSL services does not work, the resolution of the problem may be tackled by three independent work groups: one belonging to each to the ISP, the owner of the data facilities (ASI), and the owner of the LEC access facilities. Each entity performs their functions without recourse to a common set of performance data or analysis tools. This causes inefficient process of trouble resolution, and has a negative impact on service downtime, leading to frustrated customers.

[0003] The telephone company personnel generally use a handheld modem tester positioned on the customer's circuit to test the line and gather performance data. This testing requires service disruption, dispatch of a technician to a customer's premises. The raw performance data requires analytical modeling to reduce the complex information to practical use.

[0004] ISP personnel had information about their internet servers but not about that portion of the circuit from the customer premises equipment (ADSL modem) to the transport facility point of handoff. While the data service provider has access to certain databases, this provider typically has limited availability to analyze real time data using analytical software tools. Accordingly, there is a need for an improved system and method of accessing and processing DSL data.

### **BRIEF DESCRIPTION OF THE DRAWINGS**

[0005] FIG. 1 is a block diagram of an embodiment of a system for accessing DSL data.

[0006] FIG. 2 is a general diagram of a screen shot that illustrates performance data that may be displayed on a user terminal.

[0007] FIG. 3 is a general diagram of a screen shot of a line analysis display.

[0008] FIG. 4 is a general diagram of a screen shot of a line code violation data display.

[0009] FIG. 5 is a general diagram of an input screen for a user.

[0010] FIG. 6 is a general diagram of a screen shot of a line card display.

[0011] FIG. 7 is a flow chart that illustrates a particular embodiment of a method of accessing and displaying DSL data.

[0012] FIG. 8 is a flow chart that illustrates another particular embodiment of a method of accessing and displaying DSL data.

[0013] FIG. 9 is a flow chart that illustrates another particular embodiment of a method of accessing and displaying DSL data.

### **DETAILED DESCRIPTION OF THE DRAWINGS**

[0014] Referring to FIG. 1, a DSL network management system having application intranet and extranet user interfaces is illustrated. The system includes a first server, such as a resource center web server 104 having an input 170 with respect to an extranet 106.

The system also includes a second server, such as a telephone number to port mapping server 102 and a plurality of regional servers 120, 122, 124, 126. The system further includes a plurality of digital subscriber line access multiplexer (DSLAM) management units 140, 142, 144, 146. Each of the DSLAM management units is coupled to a plurality of DSLAM equipment units, such as DSLAM equipment 150-164 as illustrated. In a particular embodiment, the DSLAM equipment supports a plurality of digital subscriber line (DSL) broadband communication links to end customer premises. The DSL links supported by the DSLAMs typically cover a diverse geographical area, such as across many states. For example, the particular illustrated system may include over six thousand DSLAMs covering over two million ADSL lines across thirteen different states.

[0015] The telephone number (TN) to port mapping server 102 is coupled to the resource center server 104 via an intermediate firewall 180. The resource center web server 104 is coupled to the extranet ISP user system 106 via a firewall 182. The resource center web server 104 provides performance analysis data 170 which may be displayed to the extranet ISP user via system 106. The port mapping server 102 includes logic to provide an extensible markup language (XML) interface 172 to external application clients 110. The server 102 also provides a telephone number interface 174 and access to performance analysis to the intranet users 108. The server 102 is further coupled to and responsive to provisioning database 112 and the network discovery and synchronization process module 114. The server 102 includes stub web servers and has access to a primary and secondary database to perform the telephone number to port mapping and performance analysis functions. An example database is implemented as an SQL type database. Server 102 is coupled to the regional servers 120 to 126 via firewall 184. Each of the regional servers 120-126 includes skeleton code and includes a data collection engine. Each regional server is coupled to a respective DSLAM management module via a communication line, such as TL1 line, labeled 178.

[0016] During system operation, an input telephone number 170 is received at the resource center web server 104, from the extranet ISP user 106. A telephone number is then passed to the server 102 across firewall 180 and is received at the stub web server. The stub web server performs a database query such as an SQL query, to the database

units which perform telephone number to port mapping. The DSL multiplexer address port corresponding to the particular telephone number received is then provided by the database to logic within the stub portion of the server 102.

[0017] The port address is then provided across firewall 184 to the designated regional server that supports a particular DSLAM having the selected port address. The port address is provided to the appropriate regional server and the regional server then communicates the port address across the communication link to the respective DSLAM management unit. For example, where the selected regional server that supports the DSLAM matching a DSL line having the input telephone number is regional server 120, the port address is then provided to the DSLAM management unit 140 which then performs real time data collection of the performance of the associated DSL line, such as a DSL line supported by DSLAM 150. After the performance test is performed and real time data for the DSL line with the selected port address is collected at the DSLAM unit, the collected data is then received at the collection engine within the regional server 120 and is passed back to the first server 102 for reporting to the appropriate user. For example, the raw data collected from regional server 120 may be processed by performance analysis tools and then the resulting processed and analyzed data may be reported to either application clients 110, intranet users 108, or extranet ISP users 106.

[0018] In another method of operation, newly provisioned telephone numbers are set-up. In this example, where the telephone number matches a DSL line that needs provisioned, the stub web server within server 102 makes a query to the provisioning database 112 to provide a newly provisioned telephone number. The newly provisioned telephone number has a matching port address which is then provided to the appropriate regional server and the provisioning instructions as well as the port address are then provided to the respective DSLAM which provides the actual provisioning of the DSL circuit. A report on the provisioning and results of provisioning tests are then collected at the collection engine within the regional server and the provisioning report is then processed and provided to respective users, such as extranet users, intranet users, or application client users.

[0019] An example of a DSL performance report that may be provided to a user of the system described in FIG. 1, is shown with respect to FIG. 2. For example, a report 200 that provides a real time loop performance analysis includes a report for a particular telephone number 202 and DSL line attributes 204 that were collected with respect to a port address matching or corresponding to the telephone number 202. An example of the data displayed includes a DSL performance matrix, bit-rate transfer speeds, and data transfer bit errors.

[0020] Referring to FIG. 3, another illustrative report 300 is shown. The report 300 is a DSL line analysis report that includes DSL parameters such as the particular ADSL line telephone number, downstream and upstream speed, downstream and upstream bit errors as well as other testing parameters, such as loop length, bridge taps, and pilot tone.

[0021] Referring to FIG. 4, another illustrative report 400 is shown. The report 400 illustrates DSL line code violations and error second rates. The line code violations and error second report includes downstream line code violations 402, upstream line code violations 404, downstream error seconds 406, and upstream error seconds 408.

[0022] Referring to FIG. 5, an input screen is shown that may be provided to a user interface such as the ISP user interface 106. A particular input screen allows an operator to enter a telephone number and user ID into the system and to provide reporting text on a particular line condition. For example, an operations technician may identify a particular error on a DSL line, such as the indicated burst error 506 with respect to the telephone number 502.

[0023] Referring to FIG. 6, another illustrative report 600 is shown, the report 600 includes circuit information for a particular DSL line, such as particular circuit card selected 606, DSL card information 602, and port information 604. The report 600 also includes additional information regarding a DSL line such as a port legend 606 and a particular circuit card legend 608. The report 600 is an example of a report of analyzed data that was collected in real time and provides an analysis for preferred presentation to an operator or user. Analytical tools may be used to help process the information retrieved and to present a user-friendly view of relevant data for the technical operator.

[0024] Referring to FIG. 7, a particular illustrative method of operation for the system of FIG. 1 is shown. A requested telephone number is received, at 702. A requested telephone number corresponds to a particular digital subscriber line (DSL) element. The telephone number is mapped to a port address for a digital subscriber line access multiplexer (DSLAM) that is in communication with the DSL element. The DSL element is located remotely from the DSLAM as shown at step 702. An interrogation request to the port address of the DSLAM is then sent to interrogate the DSL element, at 704. Raw performance for the DSL element is collected in response to the interrogation request, at 706. The raw performance data collected for the DSL element is then converted to analyzed performance data, at 708. The analyzed performance data may be displayed, as shown in 710. Optionally, the raw performance data collected may be processed and analyzed to identify faulty operation indicators with respect to the DSL line, as shown at step 712. Examples of faulty operation indicators include bridge tap faults, single frequency interference faults, and disturber circuit faults. These faulty operation indicators typically correspond to conditions that reduce the data rate of the DSL line and such faulty operation indicators are often useful metrics to be reported to operations personnel.

[0025] Referring to FIG. 8, another illustrative method of operation is shown. A requested telephone number is received, at 802. The requested telephone number corresponds to a particular DSL line. The telephone number received is then mapped to a port address associated with network equipment that supports the DSL line, at step 804. The DSL line element is located remotely from the network equipment. At step 806, a provisioning status request is sent to the port address to interrogate the DSL line element. Real-time provisioning data of the DSL element is collected in response to the interrogation request, at step 808. The real-time provisioning data is analyzed to provide provisioning status data, as shown at step 810. The provisioning status data may then be displayed on a report, at step 812. In the illustrated embodiment, a port number is communicated from a server to a regional server prior to the provisioning status request. As shown at step 814, the port number being communicated to a regional server is useful where the system is a diverse system covering a wide geographical area. The regional

server may send a data request to the network management system coupled to the network equipment, as shown at step 816.

[0026] An example of the provisioning status data is a condition such as powered on, powered off, attempt to synchronize and end synchronization. The provisioning status data provided by the method illustrated in FIG. 8, may include provisioning parameters, such as equipment port status, cross connect status, alarm status, and in-service status. In a particular embodiment, the provisioning data may be pulled with respect to many deployed network equipment elements to cross check provisioned assignment data used regarding telephone number to port mapping. Fuel configurations of the deployed network equipment may be verified.

[0027] In a particular embodiment, the requested telephone number may be received via a web browser interface provided by a gateway server and the telephone number may be mapped to the port address by a broadband server that is responsive to a gateway server. The broadband server may use an extensible mark-up (XML) language interface to an application client server. The application client server may have access to the broadband server and to a user of the web browser via a common set of software tools with respect to provisioning status data.

[0028] In another illustrative embodiment, a first entity uses the web browser interface while a second entity is using the client application for concurrent operation of the broadband server and access of network equipment data. The first entity may be an internet service provider (ISP) and the second entity may be a local exchange carrier, such as an operator of a telephony switch network. Referring to FIG. 8, a historical log file may be created to record historical trouble events and user comments, as shown at 818. The log file is accessible to a plurality of operational personnel working groups, such as via the intranet user interface. The operations of scheduling and launching an automated routine to poll the provisioning data of the distributed network elements is shown, at step 820. Thus, an automated routine with a scheduled application may be deployed using a computer-based system to provide for updated provisioning status data and real time data collection of provisioning status data.

[0029] Referring to FIG. 9, another illustrative method of operation is shown. A telephone number is received via a browser input in response to a data service subscriber problem investigation request, at step 902. The telephone number corresponds to a broadband data transport element. The telephone number is mapped to a port address for network equipment that is associated with the broadband data transport element, at 904. An interrogation request to the port address is sent to interrogate the network equipment in order to retrieve real time performance data of the broadband data transport element, as shown at step 906. Raw performance data is collected for the broadband data transport element in response to the interrogation request, at 908. Raw performance data collected is then converted to analyze performance data using a set of analysis rules, at 910. Analyzed performance data is then displayed, at 912, and the performance data may optionally be processed further to identify fault conditions of the broadband data transport element, as shown at step 914. The identified fault conditions may also be displayed in an operations report via a web browser user interface or other user interface. In a particular embodiment, the broadband transport element is a data modem, such as an asynchronous digital subscriber line (ADSL) modem. The raw performance data is collected while the transport element remains in operation. By performing data collection while the transport elements remain in operation, downtime maintenance is advantageously reduced.

[0030] The disclosed system and method provides for automated remote collection of performance data directly from network elements and a method for analysis of training session data to determine indications of fault conditions. The disclosed system and method provides access to real time data and real-time data analysis tools for operations personnel. The system disclosed presents a network architecture of servers that cooperatively support different working group access to ADSL provisioning and performance data using a common set of analytical tools. The system provides for a user-friendly web browser interface for system access and shared methods for interacting with the system by various working groups. Data is extracted from production ADSL equipment in real-time with respect to particular ADSL telephone numbers. Network equipment configuration information is also provided to operations personnel to assist in



resolving circuit performance provisioning issues. Examples of circuit provisioning parameters that may be observed by various working groups includes ADSL equipment port status, ATM cross-connect status or alarms status, in service, or out of service data.

[0031] The system also provides features such as traffic flow control that is instituted to reduce operational overload conditions. The system provides for a basic inquiry identified by a telephone number that is tied to provisioning flows and maintenance via a remote automated system. In addition, the system polices the accuracy of its telephone number look-up database by polling network equipment on a periodic basis, such as daily or weekly, to cross-check the provisioned assignment with actual field configurations. In addition, the system may support thousands of real-time users over a geographically diverse area and features a historical log that is tagged by telephone numbers that may be accessed by working groups to record historical trouble events or pass along other operator comments. Further, the system supports a method of operation that is automated and provides for performance measurements without requiring special test equipment or special personnel dispatch to the field for analysis. Real-time collection and analysis rules may be used beneficially to discover line problems at an early point of detection to reduce service impact. Reducing reliance on on-site technicians allows the system to support management at a centralized site that covers a wide range of area.

[0032] The above disclosed subject matter is to be considered illustrative, and not restrictive, and the appended claims are intended to cover all such modifications, enhancements, and other embodiments which fall within the true spirit and scope of the present invention. Thus, to the maximum extent allowed by law, the scope of the present invention is to be determined by the broadest permissible interpretation of the following claims and their equivalents, and shall not be restricted or limited by the foregoing detailed description.